IIC Brazil Summer Policy Lab

Hydropower Construction and Deforestation: Linking Forest Cover to Changes in Water Balance

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Hydropower construction represents the largest potential driver of deforestation in the Amazon as a result of: (1) Road construction creating access to remote areas; (2) Migrant workers leading to rapid increases in population density; and (3) Infrastructure construction necessary to support this population growth. As of November 2015, 237 dams were planned or under construction in the Brazilian Amazon [1]. Hydropower construction in the Tapajós River Basin represented one third of this total. The amount of deforested area in the Tapajós River Basin was estimated to be between 42% and 105% greater than background rates of deforestation by 2030 (Fig. 1). In early August 2016 the environmental license to build the largest of these dams, the São Luiz do Tapajós, was denied. However, construction of 43 dams are still planned for construction. Our approach remains applicable for future scenarios associated with hydropower construction or any other driver of deforestation in the Amazon.

The Effect of Deforestation on Local and Regional Water Balance

Rainfall is dependent on both the volume of water and the energy required to move this water from soil to the atmosphere through evapo-transpiration (ET). Deforestation is known to have several effects on this process. First, The clearing of forests for pasture or crop production increases the speed and volume of water discharge while dramatically reducing the amount of energy and water returning to the atmosphere [3]. This increases seasonal variability in water flow and changes the ecological function of rivers and streams.

The forest provides a slow release of water into streams during the dry season, which is especially important for consistent hydroelectric power generation [4]. In addition, pastures and crop fields reflect

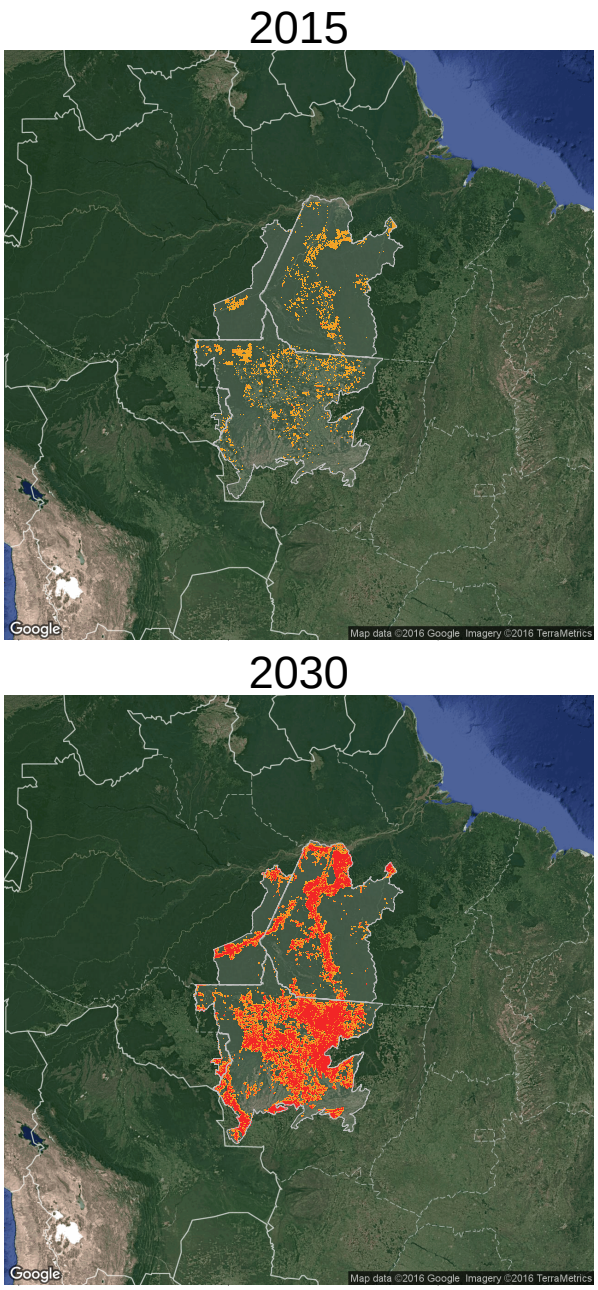

Figure 1: Observed deforestation in 2015 and projected deforestation in 2030 among municipalities in the Tapajós river basin.

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energy from the sun back to the atmosphere rather than releasing it through ET. This effect is known to have measurable effects on rainfall [2]. As a result of removing water from the atmosphere and changing the energy balance, rainfall is expected to decrease at local and regional scales. This could negatively affect rainfall dependent crop production, resulting in less product and/or increased irrigation costs.

Our Question

How will deforestation in the Tapajós River Basin affect seasonal variability in water discharge, ET and net energy (rainfall potential)? Below, we use results from land-surface modeling (IBIS) to quantify the effect of deforestation on the magnitude of change in these water balance characteristics [2].

Results and Recommendations

Figure 2 shows the effect of deforestation on discharge and ET for each month from year 2000 to 2014. If there were no effect of deforestation we would expect both lines to be flat at a ratio of 1 across all months. Instead, water discharge and ET are more strongly affected by deforestation during the wet season, which we would expect for high rates of water runoff. Figure 3 shows the relationship between net energy and deforested area. Of the three variables addressed here, net energy was affected most strongly by deforestation. We recommend the following policy strategies to avoid or offset these effects:

- As a result of creating an unreliable source of water when its needed, hydropower construction undermines its own potential for energy production through deforestation. We suggest the use of alternative energy strategies which maintain the proper functioning of the water cycle such as solar and wind energy.
- Deforestation in one place can affect rainfall hundreds of miles away. Policies which reduce the costs of forest restoration and incentivise the maintenance of forested areas should be made a priority.
- In an effort to maintain a functioning water cycle for both river discharge and rainfall, government funded construction projects should bear some cost for funding this restoration.

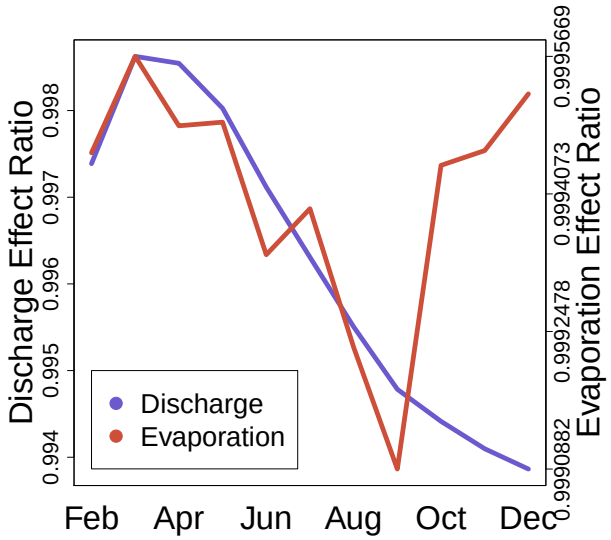

Figure 2: The seasonal effects of deforestation on river discharge and ET from forests.

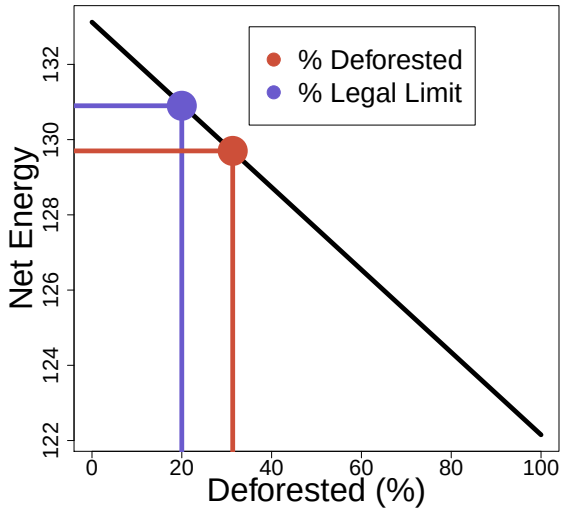

Figure 3: Difference in net energy (rainfall potential) under the legal limit of deforested area (blue) and observed level of deforestation (red).

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Acknowledgements

We thank Ane Alencar and Isabel Silva from IPAM and Michael Coe from WHRC for helpful guidance and access to deforestation data and simulation results.